Rank correlation between Two Interval Valued Intuitionistic fuzzy Sets

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Abstract:

In this paper we investigated the correlation between two interval valued intuitionistic fuzzy sets defined on the same universal support. It is shown that Spearman's rank correlation coefficient can be applied in the members of the supports are ranked according to the interval valued intuitionistic fuzzy membership and non-membership values of each set. Next a membership and non-membership value–basedinterval valued intuitionistic fuzzy rank correlation measure is proposed and its example arederived.

Keywords:

Correlation, Random variable,Spearman's Rank correlation,Interval valued Intuitionistic fuzzy sets .

Introduction:

Interval valued Intuitionistic Fuzzy set theory is a powerful tool to model imprecise and vague situations where exact analysis is either difficult or impossible. Central to the theory is the concept of Interval valued intuitionistic fuzzy set, which is generalization of the ordinary (crisp) set that captures gradual transition from belongingness to the set .

It is often theoretically interesting and practically necessary to see how different properties of crisp set can be generalized in Interval valued intuitionistic fuzzy situations. Such studies led to enormous interesting result.

In statistics and in engineering sciences a concept called rank correlation is often used. By rank correlation analysis the joint relationship of two variables can be examined with the aid of a measure of interdependence of the two variables. Typical subjects for rank correlation analysis are the interdependence (association) between height of father and height of(adult) son, between score in mathematics and score in statistics, etc. In all these cases the value taken by the variablesis objective andthe value obtained is the outcome of a purely random event.

If (x_i ,y_i; i=1,2,…..n) is the data set, then the rank correlation between x and y is defined as $\rho = 1 - \frac{6d^2}{n(n^2-1)}$where d_i= $R_1 - R_2$is the rank between x and y. But in reality there are many situations where instead of the measured values of the two variables of someobjects or entities the ranks of the objects according to the two variables or according to two different qualitative characteristics is available. In this case rank correlation is used to correlate the two sets of availabledata. Such a situation arises when we have a qualitative rather than quantitative knowledge of the samples which can be ranked according to quality. Consider, for example, the quality of handwriting of individuals which has no obvious way to quantify. A typical rank correlation measure is due to Spearman [2]. But an interesting case arises if instead of ranks some subjective grading of the elements is available (the grading may be continuous or discrete). Then a interval valued intuitionistic fuzzy set can be formed based on such grading and the relation between two such interval valued intuitionistic fuzzy sets can be obtained by comparing the respective membership and non-membership values in the sets.

INTERVAL-VALUED INTUITIONSTIC FUZZY SET

An interval-valued intuitionistic fuzzy set(IVIFS) A in X, X≠Ø and card(X)=n, is an object having the form: $A = \{\langle x, \mu_A(x)\ ), \gamma_A(x)\ \rangle : x \in X\}$ Where$\mu_A : X \longrightarrow [0,1]$,$\gamma_A$: $X \longrightarrow [0,1]$ with the condition sup$\mu_A(x)$+sup $\gamma_A(x) \leq 1$ for any $x \in X$. The intervals $\mu_A(x)$ and $\gamma_A(x)$ denote,respectively, the degree of belongingness and the degree of non-belongingness of the element x to A. We denote by IVIFS(X) the set of all IVIFSs in X.Then for each $x \in X$, $\mu_A(x)$ and $\gamma_A(x)$ are closed intervals and their lower and upper end points are denoted by $\mu_{AL}(x)$, $\mu_{Au}(x)$, $\gamma_{AL}(x)$ $\gamma_{Au}(x)$ respectively,and thus we can replace with $A = \{\langle x, [\mu_{AL}(x), \mu_{Au}(x)], [\gamma_{AL}(x), \gamma_{Au}(x)\ ]\rangle : x \in X\}$ where $0 \leq \mu_{Au}(x) + \gamma_{Au}(x) \leq 1$ for any $x \in X$.For each A∈INVIFS(X) we call$\pi_A(X)$ $=1- \mu_A(x)- \gamma_A(x)=[1- \mu_{Au}(x)- \gamma_{Au}(x),1- \mu_{AL}(x)-\gamma_{Au}(x)]$ an intuitionstic fuzzy interval of X in A. us lower and upper points are $\pi_{AL}(X)=1- \mu_{Au}(x)- \gamma_{Au}(x)$ and $\pi_{Au}=1- \mu_{AL}(x)- \gamma_{AL}(x)$,respectively.

The following expression are defined for A,B∈ INVIFS(X);

A≤B⇔ $\mu_A(x) \leq \mu_B(x)$ and $\gamma_A(x) \geq \gamma_B(x)$ for all $x \in X$;

A=B⇔ $\mu_A(x) = \mu_B(x)$ and $\gamma_A(x) = \gamma_B(x)$ for all $x \in X$;

$A^c \Leftrightarrow \{\langle x, \mu_A(x)\ ), \gamma_A(x)\ \rangle : x \in X\}$.

$A \prec B \Rightarrow \mu_A(x) \leq \mu_B(x)$ and $\gamma_A(x) \leq \gamma_B(x)$ for all $x \in X$.

The operational relation and defined for A,B∈ INVIFS(X) and lampa>o;

$A \cap B = \langle [min\ \mu_{AL}(x), \mu_{BL}(x), min\ \mu_{AU}(x), \mu_{BU}(x)], [max(\gamma_{AL}(x), \gamma_{BL}(x)), max(\gamma_{AU}(x), \gamma_{BU}(x))] \rangle$;

$A \cup B = \langle [max\ (\mu_{AL}(x), \mu_{BL}(x)), max(\mu_{AU}(x), \mu_{Au}(x))], [min\ (\gamma_{AL}(x), \gamma_{BL}(x)), min(\gamma_{AU}(x), \gamma_{AU}(x))]\ \rangle$;

$A+B = \langle [\ \mu_{AL}(x) + \mu_{BL}(x) - \mu_{AL}(x)\ \mu_{BL}(x), \mu_{AU}(x) + \mu_{BU}(x) - \mu_{AU}(x)\ \mu_{BU}(x)], [\gamma_{AL}(x)\ \gamma_{BL}(x), \gamma_{AU}(x)\ \gamma_{BU}(x)]\ \rangle$;

$AB = \langle [\ \mu_{AL}(x)\ \mu_{BL}(x), \mu_{AU}(x) \mu_{BU}(x)]$,

$[\gamma_{AL}(x)+\gamma_{BL}(x)-\gamma_{AL}(x)\gamma_{BL}(x), \gamma_{AU}(x)+\gamma_{BU}(x)-\gamma_{AU}(x)\gamma_{BU}(x)]\ \rangle$;

$\lambda_A = \langle [1-(1- \mu_{AL}(x))^{\lambda}, 1-(1- \mu_{AL}(x))^{\lambda}], [\ \gamma^{\lambda}_{AL}(x), \gamma^{\lambda}_{AU}(x)]\ \rangle$;

$A^{\lambda} = \langle [\ \mu^{\lambda}_{AL}(x), \mu^{\lambda}_{AU}(x), 1-(1-\gamma_{AL}(x)^{\lambda}), 1-(1-\gamma_{AL}(x))^{\lambda}\ ]\ \rangle$.

OPERATORS OVER INTERVAL VALUED IFS$_S$

The interval valued intuitionstic fuzzy sets(IVIFS$_S$) were defined as extension as of the intuitionstic fuzzy set(IFS$_S$).An IVIFS A over E is an object having the form: $A = \{\langle x, M_{1(x)}, N_A(x)\ \rangle / \ x \in X\}$,where $M_A(x) \subset [0,1]$ and $N_A(x) \subset [0,1]$ are intervals and for every $x \in$E. sup $M_A(x)$+sup $N_A(x\ ) \leq 1$. Obviously, when each of the intervals $M_A(x)$ and $N_A(x\ )$contains exactly one element each of themi.e., when for every $x \in$E:$\mu_A(x)$=inf $M_A(x)$=sup $M_A(A)$,

$\gamma_A(x)$=inf $N_A(x)$=sup $N_A(x)$=sup $N_A(x)$,the given IVIFS is transformed to an ordinary IFS.On the other hand, when $N_A(x)=\emptyset$ for every $x \in$E, the given IVIFS is transformed to an ordinary interval valued fuzzy set.

We note that the transformation formulas between an IVIFS and an interval valued fuzzy set are the following:

a) When the IVIFS A is given, then we can construct, corresponding to it, an interval valued fuzzy set B for which $M_B(x)=[\mu_A(x), 1-\gamma_A(x)]$;

a) When the interval valued fuzzy set B is given, we can construct,

corresponding to it, an IVIFS A for which

$$\mu_A(x)=\inf M_B(x), \gamma_A(x)=1-\sup M_B(x).$$

Here we shall present different operators Over the IVIFS$_S$. They are analogous to the operators,defined over the IFS and on the other hand some of them can also be transformed over the interval valued fuzzy set. Some of the operators are specific and they can be applied only over the IVIFS$_S$. Situationis analogues to the situation in the IFS theory.for example, operators □ and ◊transform agiven IFS to ordinary sets and we have that.

$$\square A \subset A \subset \lozenge A$$

For every IFS A, while for every ordinary fuzzy set

$\Box A = A = \Diamond A$

i.e., the two operators are senseless in the frams of the fuzzy set theory.

For every two IVIFS$_S$ A and B the following relation and operations are valid

$A \subset_{\Box,\inf} B$ iff $(\forall x \in E)$ $(\inf M_A(x) \leq \inf M_B(x))$,

$A \subset_{\Box,\sup} B$ iff $(\forall x \in E)$ $(\sup M_A(x) \leq \sup M_B(x))$,

$A \subset_{\Box,\inf} B$ iff $(\forall x \in E)$ $(\inf N_A(x) \geq \inf N_B(x))$,

$A \subset_{\Box\sup} B$ iff $(\forall x \in E)$ $(\sup N_A(x) \geq \sup N_B(x))$,

$A \subset_{\Box} B iff A \subset_{\Box,\inf} B \& A \subset_{\Box,\sup} B$,

$A \subset_{\Box} B iff A \subset_{\Box,\inf} B \& A \subset_{\Box,\sup} B$,

$A \subset B iff A \subset_{\Box} B \& B \subset_{\Box} A$,

$A = B$ iff $A \subset B \& B \subset A$

$A = \{\langle x, N_A(x), M_A(x) \rangle / x \in E\}$

$A \cap B = \{\langle x, [min(\inf M_A(x), \inf M_B(x)), min(\sup M_A(X), \sup M_B(x))], [max,(\inf N_A(x), \inf N_B(x), max(\sup N_A(x) \sup N_B(x))] \rangle / x \in X\}$,

$A \cap B = \{\langle x, [max(\inf M_A(x), \inf M_B(x)), min(\sup M_A(X), \sup M_B(x))], [min,(\inf N_A(x), \inf N_B(x), min(\sup N_A(x) \sup N_B(x))] \rangle / x \in X\}$,

$A + B = \{\langle x, [\inf M_A(x) + \inf M_B(x) - \inf M_A(X) \inf M_B(x), \sup M_A(X) + \sup M_B(x) - \sup M_A(X).\sup M_B(x)], [\inf N_A(x), \inf N_B(x), \sup N_A(x) \sup N_B(x))] \rangle / x \in X\}$,

$A.B = \{\langle x, [\inf M_A(x), \inf M_B(x) - \sup M_A(X), \sup M_B(x)], [\inf N_A(X) + .\inf N_B(x) - \inf] N_A(X) .\inf N_B(x), \sup N_A(x) + \sup N_B(x) - \sup N_A(x) \sup N_B(x))] \rangle / x \in X\}$,

$A@B = \{\langle x, 1/2(\inf M_A(x) + \inf M_B(x), 1/2(\sup M_A(x) + \sup M_B(x))], [1/2(\inf N_A(x) +, \inf N_B(x), 1/2(\sup N_A(x) + \sup N_B(x)] \rangle / x \in X\}$,

$A\$B = \{\langle x = [\sqrt{\inf M_A(x), \inf M_B(x)}, \sqrt{\sup M_A(x), \sup M_B(x)}]$

$[\sqrt{\inf N_A(x), \inf N_B(x)}, \sqrt{\sup N_A(x), \sup N_B(x)}] \rangle / x \in X\}$

$A\# B = \{\langle x, \left[\frac{2.(\inf M_A(x), \inf M_B(x)}{\inf M_A(x) + \inf M_B(x)}, \frac{2.\sup M_A(x), \sup M_B(x)}{\sup M_A(x) + \sup M_B(x)}\right].$

$\left[\frac{2.(\inf N_A(x), \inf N_B(x)}{\inf N_A(x) + \inf N_B(x)}, \frac{2.\sup N_A(x), \sup N_B(x)}{\sup N_A(x) + \sup N_B(x)}\right] \rangle / x \in X\}$

$A^*B = \{\langle x, \left[\frac{\inf M_A(x) + \inf M_B(x)}{2.(\inf M_A(x), \inf M_B(x) + 1)}, \frac{\sup M_A(x) + \sup M_B(x)}{2.\sup M_A(x), \sup M_B(x) + 1)}\right]$
$\left[\frac{\inf N_A(x) + \inf N_B(x)}{2.(\inf N_A(x), \inf N_B(x) + 1)}, \frac{\sup N_A(x) + \sup N_B(x)}{2.\sup N_A(x), \sup N_B(x) + 1)}\right] \rangle / x \in X\}$

Let A be an IVIFS over E_1 and B over E_2, we define,

$A \times_1 B = \{\langle x,y \rangle, [\inf M_A(x), \inf M_B(y), \sup M_A(x) \sup M_B(y)], [\inf N_A(x), \inf N_B(y), \sup N_A(x) \sup N_B(y)] \rangle / x \in E_1, y \in E_2\}$,

$A \times_2 B = \{\langle\langle x,y \rangle, [\inf M_A(x) + \inf M_B(y) - \inf M_A(x), \inf M_B(y)], [\sup M_A(x) + \sup N_B(y) - \sup M_A(x) + \sup N_B(y)], [\inf N_A(x), \inf N_B(y), \sup N_A(x) \sup N_B(y)] \rangle / x \in E_1, y \in E_2\}$,

$A \times_3 B = \{\langle\langle x,y \rangle, [\inf M_A(x), \inf M_B(y), \sup M_A(x) \sup M_B(y)], [\inf N_A(x) + \inf N_B(y) - \inf N_A(x), \inf N_B(y) \sup N_A(x) + \sup N_B(y) - \sup N_A(x) \sup N_B(y)] \rangle / x \in E_1, y \in E_2\}$,

$A \times_4 B = \{\langle\langle x,y \rangle, min(\inf M_A(x), \inf M_B(y), \sup M_A(x) \sup M_B(y))]$
$[max(\inf N_A(x), \inf N_B(y)), max(\sup N_A(x) \sup N_B(y)) / x \in E_1, y \in E_2\}$,

$A \times_5 B = \{\langle\langle x,y \rangle, [max(\inf N_A(x), \inf N_B(y), min(\sup N_A(x) \sup N_B(y)] \rangle / x \in E_1, y \in E_2\}$.

It is easy to see the correctness of the defined operations and relations. The asseration can be transformed here with the necessary correction and their validity is changed similarly.

2.2. Interval valued Intuitionistic Fuzzy membership Rank correlation measure :

Let there be two non-empty intuitionistic fuzzy sets A and B defined on the same universe X. Let an element x∈X belong to set A with membership value μ_A and non- membership value $\gamma_A$and to set B with membership value $\mu_B$and non- membership value γ_B where μ and γ lie in the interval [0,1] for all x∈X.

The proposed rank correlation measure should be symmetric with respect to μ,γ and it must also depend on the membership values of all x∈X.

Since conventional rank correlation measure lies in [−1;1], it is expected thatintuitionistic fuzzy measure should also lie in this range. The measure should also be independent of change of scale of membership and non-membership values. To achieve both the objectives we use a normalised form

Consider two intuitionistic fuzzy sets

First IFS is $[\mu_{AL,}\ \mu_{Au}, \gamma_{AL,}\ \gamma_{Au}]$

Second IFSis $[\mu_{BL,}\mu_{Bu,}\gamma_{BL,}\gamma_{Bu}]$

Where $\mu_{AL}, \mu_{BL}, \mu_{Au}, \mu_{Bu}$ are Membership

$\gamma_{AL,}\gamma_{BL,,}\gamma_{Au}, \gamma_{Bu}$ are non_Membership each of the Variable

$[\mu_{AL,}\ \mu_{Au}, \gamma_{AL,}\ \gamma_{Au}]$& $[\mu_{BL,}\mu_{Bu,}\gamma_{BL,,}, \gamma_{Bu}]$.

Takes the Values of 1,2,3……….n.

Hence$[\mu\square_{AL} - \mu\square_{BL})=(\mu\square_{Au} - \mu\square_{Bu})=(\gamma\square_{AL} - \gamma\square_{BL,})=(\gamma\square_{Au} - \gamma\square_{Bu})=\left(\frac{n+1}{2}\right)$

$\sigma\mu^2_{L,u}= \frac{1}{n}\{(\mu_{AL} - \mu_{BL})-(\mu\square_{AL} - \mu\square_{BL})+(\mu_{Au} - \mu_{Bu})-(\mu\square_{Au} - \mu\square_{Bu})\}$

$= \frac{1}{n}\{\left(1^2 + 2^2 + \cdots \ldots . + n^2 - \left(\frac{n+1}{2}\right)^2\right) + \left(1^2 + 2^2 + \cdots \ldots . + n^2 - \left(\frac{n+1}{2}\right)^2\right)\}$

$=\frac{n^2-1}{12} + \frac{n^2-1}{12}$

$=\frac{2\,(n^2-1)}{12}$

In general $d\mu_L=(\mu_{AL} - \mu_{BL})$, $d\mu_u=(\mu_{Au} - \mu_{Bu})$,$d\gamma_L=(\gamma_{AL,} - \gamma_{BL})$,$d\gamma_u=(\gamma_{Au} - \gamma_{Bu})$

Let we consider,

$d\mu_L=(\mu_{AL} - \mu_{BL})-(\mu\square_{AL} - \mu\square_{BL})$

$d\mu_u=(\mu_{Au} - \mu_{Bu})-(\mu\square_{Au} - \mu\square_{Bu})$

$d\gamma_L=(\gamma_{AL,} - \gamma_{BL})-(\gamma\square_{AL} - \gamma\square_{BL,})$

$d\gamma_u=(\gamma_{Au} - \gamma_{Bu})-(\gamma\square_{Au} - \gamma\square_{Bu})$

Squaring and Subracting

$\{[\Sigma\, d\mu_L+\Sigma d\mu_u]-[\Sigma\, d\gamma_L+\Sigma d\gamma_u]\}^2= \{[(\mu_{AL} - \mu_{BL})-(\mu\square_{AL} - \mu\square_{BL})+(\mu_{Au} - \mu_{Bu})-(\mu\square_{Au} - \mu\square_{Bu})]-$

$[(\gamma_{AL,} - \gamma_{BL})-(\gamma\square_{AL} - \gamma\square_{BL,})+(\gamma_{Au} - \gamma_{Bu})-(\gamma\square_{Au} - \gamma\square_{Bu})]\}^2$

$=[(\mu_{AL} - \mu_{BL})-(\mu\square_{AL} - \mu\square_{BL})+(\mu_{Au} - \mu_{Bu})-(\mu\square_{Au} - \mu\square_{Bu})]^2+[(\gamma_{AL,} - \gamma_{BL})-(\gamma_{AL} - \gamma\square_{BL,})+$

$(\gamma_{Au}- \gamma_{Bu})- (\gamma\square_{Au}- \gamma\square_{Bu})]^2-2[(\mu_{AL}- \mu_{BL})-(\mu\square_{AL} - \mu\square_{BL})+ (\mu_{Au}- \mu_{Bu})-(\mu\square_{Au}- \mu\square_{Bu})]$

$[(\gamma_{AL,}-\gamma_{BL})- (\gamma\square_{AL}- \gamma\square_{BL,}+ (\gamma_{Au}- \gamma_{Bu})- (\gamma\square_{Au}- \gamma\square_{Bu})]$

$= \Sigma\{ \sigma\mu^2_{LU}+ \sigma\gamma^2_{u,L}-2 \text{ cov}(\mu_{LU,}\gamma_{LU})\}$

Let$\mu=\gamma$

$\Sigma\{ \sigma\mu^2_{LU}+ \sigma\gamma^2_{u,L}-2\rho(\sigma\mu_{LU}+ \sigma\gamma_{u,L})$

$=\Sigma\{ \sigma\mu^2_{LL}+ \sigma\mu^2_{LL}-2 \rho(\sigma\mu_{LL}+ \sigma\mu_{LL})$

$= \Sigma \{2 \sigma\mu^2_{LL}-2 \rho \sigma\mu^2_{LL}\}$

$= 2 \sigma\mu^2_{LL}(1- \rho)$

Dividing by n

$1/n\{[\Sigma d\mu_L+\Sigma d\mu_u]-[\Sigma d\gamma_L+\Sigma d\gamma_u]\}^2= 2 \sigma\mu^2_{LL}(1- \rho)$

$(1-\rho)= \frac{1}{n}\frac{\{\Sigma[d\mu_L+ d\mu_U]-\Sigma[d\gamma_L+ d\gamma_U]\}^2}{2\sigma_{\mu LL}{}^2}$

$\rho = 1-\frac{\{\Sigma[d\mu_L+ d\mu_U]-\Sigma[d\gamma_L+ d\gamma_U]\}^2}{2n\sigma_{\mu LL}{}^2}$

$\rho = 1 - \frac{6\,\{\Sigma[d\mu_L+ d\mu_U]-\Sigma[d\gamma_L+ d\gamma_U]\}^2}{2n(n^2-1\,)}$

Problem;

To find the Rank correllationbetween two Interval valued Intuitionstic fuzzy set.

SL.NO	A				B			
	μ_{AL}	μ_{BL}	μ_{AU}	μ_{BU}	γ_{AL}	γ_{BL}	γ_{AU}	γ_{BU}
1	**0.005**	**0.006**	**0.004**	**0.006**	**0.001**	**0.007**	**0.008**	**0.018**
2	**0.003**	**0.005**	**0.010**	**0.012**	**0.022**	**0.024**	**0.024**	**0.025**
3	**0.006**	**0.007**	**0.012**	**0.016**	**0.018**	**0.020**	**0.022**	**0.023**
4	**0.005**	**0.007**	**0.014**	**0.018**	**0.020**	**0.024**	**0.025**	**0.026**
5	**0.001**	**0.004**	**0.020**	**0.022**	**0.024**	**0.026**	**0.028**	**0.030**
6	**0.002**	**0.003**	**0.022**	**0.024**	**0.024**	**0.028**	**0.001**	**0.009**
7	**0.004**	**0.005**	**0.018**	**0.020**	**0.026**	**0.030**	**0.008**	**0.010**
8	**0.001**	**0.002**	**0.012**	**0.015**	**0.012**	**0.018**	**0.009**	**0.015**
9	**0.004**	**0.007**	**0.011**	**0.012**	**0.017**	**0.019**	**0.010**	**0.015**
10	**0.008**	**0.010**	**0.014**	**0.018**	**0.006**	**0.008**	**0.015**	**0.018**

SOLUTION

$\rho = 1 - \frac{6\,\{\Sigma[d\mu_L+ d\mu_U]-\Sigma[d\gamma_L+ d\gamma_U]\}^2}{2n(n^2-1\,)}$

$d\mu_L=(\mu_{AL}-\mu_{BL})$, $d\mu_u=(\mu_{Au}-\mu_{Bu})$,$d\gamma_L=(\gamma_{AL,}-\gamma_{BL})$,$d\gamma_u=(\gamma_{Au}-\gamma_{Bu})$

$d\mu_L=(\mu_{AL}-\mu_{BL})$	$d\mu_u=(\mu_{Au}-\mu_{Bu})$	$d\gamma_L=(\gamma_{AL,}-\gamma_{BL})$	$d\gamma_u=(\gamma_{Au}-\gamma_{Bu})$	$d\mu_L+d\mu_u$	$d\gamma_L+d\gamma_u$	$(d\mu_L+d\mu_u)+(d\gamma_L+d\gamma_u)$	$\{(d\mu_L+d\mu u)+(d\gamma_L+d\gamma u)\}^2$
-0.001	-0.002	-0.006	-0.010	-0.003	-0.016	-0.019	0.000361
-0.002	-0.002	-0.002	-0.001	-0.004	-0.003	-0.009	0.000081
-0.001	-0.004	-0.002	-0.001	-0.005	-0.003	-0.008	0.000064
-0.002	-0.004	-0.004	-0.001	-0.006	-0.005	-0.011	0.000121
-0.003	-0.002	-0.002	-0.002	-0.005	-0.004	-0.009	0.000081
-0.001	-0.002	-0.004	-0.008	-0.003	-0.012	-0.015	0.000225
-0.001	-0.002	-0.004	-0.002	-0.003	-0.006	-0.009	0.000081
-0.001	-0.003	-0.006	-0.006	-0.004	-0.012	-0.016	0.000256
-0.004	-0.001	-0.002	-0.005	-0.005	-0.007	-0.012	0.000144
-0.002	-0.004	-0.002	-0.003	-0.006	-0.005	-0.011	0.000121

$$\rho = 1-\frac{6\{\sum[d\mu_L+d\mu_U]-\sum[d\gamma_L+d\gamma_U]\}^2}{2n(n^2-1)}$$

$\sum d\mu_L=-0.018$, $\sum d\mu_u=-0.026$, $\sum d\gamma_L=-0.034$, $\sum d\gamma_u=-0.039$ n=10

$$\rho = 1-\frac{6\{[(-0.018)+(-0.026)]-[(-0.034)+(-0.039)]\}^2}{2(10)(10^2-1)}$$

$$=1-\frac{6\{[-0.044]-[-0.0730]\}^2}{2(10)(10^2-1)}$$

$$=1-\frac{6\{(-0.117)\}^2}{(20)(100\ \ -1)}$$

$=1—0.7020$

$$=1-\frac{(-0.7020)}{1980}$$

=1-0.0003545

$\rho=0.99$

Conclusion:

Already create fuzzy rank correlation in [3]and we have used the fuzzy rank correlation coefficient for creating intuitionisticfuzzy rank correlation. And also we derived the numerical example in intuitionistic fuzzy rank correlation.

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